PATENT APPLICATION

<u>High Torque and High Capacity Rotatable Center Core with Ram Body Assemblies</u>

This application is a continuation-in-part application of my application filed 3 July 2003 bearing serial number 10/190,193, which is a continuation-in-part of my application filed 26 November 2001 bearing serial number 09/994,161.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The system of the present invention relates to high torque and high capacity rotatable center core and seal body assemblies with universal ram applications and the method of undertaking same. More particularly, the present invention relates to an apparatus that would allow one to pick up the entire weight of the drill string, tubing or pipe which would allow one to rotate from the top and have the torque completely through it while rotating.

2. General Background of the Invention

In undertaking wireline work utilizing a side entry device, in the present state of the art, the device includes a packoff assembly or grease seal assembly at the entry to the side entry port or top entry port which provides for protection against blowouts while the device is in use. However, while wireline is being lowered through the device, there must be an additional method to seal off the passageway while the wireline is in place. Therefore, there are provided blowout preventors positioned below the wireline packoff on the side entry device which may be manually or hydraulically closed to seal off the wireline in case of a blowout. Such blowout preventors are manufactured by, for example, Bowen Oil Tools Inc.

However, it would be beneficial to have such a blowout preventor located in the drill

string itself, above the rig floor, which would allow the wireline to be sealed off below the swivel. In that manner, when the drill string below the swivel needs to be rotated to provide torque, the blowout preventors would simply rotate with the drill string. However, in the case of a blowout, or in the event work needed to be done above the swivel above this side entry device, while the well is under pressure, the blowout preventors could be closed off. The type of blowout preventors currently used, as discussed above, manufactured by Bowen Inc., would not have the capability of being placed within the drill string, since the device could not withstand the enormous weight of the drill string below the preventors. So, there is a need for a type of blowout preventors that can be positioned below the swivel, within the drill string, that can be maintained open, and allow to rotate freely with the string, but in the event work needed to be done above the device, the blowout preventors would be closed, and the well, although under pressure would not be capable of blowing out during the curative work. The system of the present invention solves many problems in the art.

BRIEF SUMMARY OF THE INVENTION

An apparatus for use in a drill string is disclosed. The apparatus includes a core assembly having a first and second transverse bore, and wherein the core assembly has a first end and a second end. The apparatus further includes first piston means, disposed within the first and said second transverse bore, for closing an internal longitudinal bore of the core assembly, and wherein the first end of the core assembly is connected to the drill string and the second end is operatively connected to a drill string pivoting member which may be a swivel, top drive or the like.

The first piston means may comprise a first piston member disposed within the first transverse bore of the core assembly, and a second piston member disposed within the second transverse bore of the core assembly, and means for moving the first and second piston member into the internal longitudinal bore of the core assembly in order to close the internal longitudinal bore.

The apparatus may further comprise a third and fourth transverse bore positioned within the core assembly and second piston means, disposed within the third and said fourth transverse bore of the core assembly, for closing the internal longitudinal bore of the inner core assembly.

In one preferred embodiment, the first piston means includes a first sleeve disposed within the first and second transverse bore of the core assembly. The sleeves are adapted to hold the piston means.

The piston means may further comprise means for moving the piston members into the internal longitudinal bore of the core assembly in order to close the internal longitudinal bore.

Also disclosed is a method of sealing off flow in a drill string during well operations. The method comprises providing an apparatus comprising an inner core assembly having a first and second transverse bore, first piston means, disposed within the first and second transverse bore of the inner core assembly, for closing an internal longitudinal bore disposed through the inner core assembly. The method further includes connecting the drill string to a first end of the inner core assembly and transmitting the weight of the drill string to the inner core assembly. Next, the drill string is rotated so that a torque is created and the torque is transmitted through the inner core assembly. The rotation of the drill string is terminated and the first piston means is closed in order to seal off the internal longitudinal bore of the inner core assembly.

The method further comprises opening the first piston means so that the internal longitudinal bore of the inner core assembly is unsealed and providing a wireline within the internal longitudinal bore of the inner core assembly. The method includes lowering a downhole assembly attached to a wireline into the drill string, closing the first piston means about the wireline within the internal longitudinal bore of the inner core assembly and performing curative work on the wireline above the first piston means. Next, the first piston means is opened so that the internal longitudinal bore of the inner core assembly is unsealed. The drill string can then be pulled out with the down hole assembly.

Also disclosed is a method of sealing off flow in a work string. This method includes providing an apparatus comprising a core having an internal bore, and wherein the core has a first end and a second end. The method includes connecting the work string to the first end of the core, and transmitting the weight of the work string to the core. The work string is rotated within the well bore so that a torque is created, and the torque is transmitted from the work string to the core. Next, the rotation of the work string is terminated and wherein a concentric tubular member is provided within the internal bore of the core. The method includes lowering the concentric tubular member into the work string and closing the first and second piston members about the concentric tubular member within the internal bore of the core.

The method further includes pumping a fluid into the work string below the apparatus and monitoring a pressure within the work string. The method may include opening the first piston member and second piston member so that the internal bore of the core is unsealed, and thereafter pulling the concentric tubular member out of the work string. The concentric tubular member may be for example, a wireline, snubbing pipe, coiled tubing, work string, etc.

This system could be used when the wire of a wireline unit balls up under the pack off or grease head flow tubes. The operator could close off the apparatus and perform the

curative work desired above the apparatus. If an unexpected pressure is exerted on the well, in order to correct the problem, one will close the rams in order to seal off the pressure; then the operators would bleed off above the rams. If one has a pump down tool below the rams, this would allow one to pump fluids downhole if one would need to kill the well.

A method of sealing off flow in a tubular string while using a concentric work string is also disclosed. The concentric work string can be a coiled tubing string. The method comprises providing a sealing apparatus having an inner core assembly. The method includes connecting the tubular string to a first end of the inner core assembly and connecting a swivel to a second end of said inner core assembly. Next, the weight of the tubular string is transmitted to the inner core assembly, and the coiled tubing is lowered into the tubular string and through the internal bore of the inner core assembly, and wherein the coiled tubing disposed within the tubular string creates an annular space.

The method further includes rotating the tubular string so that a torque is created, and transmitting the torque through the inner core assembly. Rotation of the tubular string is terminated and the piston means is closed about the coiled tubing in order to seal off the annular space. Next, a fluid is pumped through a side entry sub located below the apparatus, the fluid being pumped into the annular space.

The method further comprises opening the piston means, contained within transverse bores in the inner core assembly, so that the annular space is unsealed and running into the well bore with the coiled tubing to a desired depth. Next, the piston means is closed about the coiled tubing thereby closing the annular space. The method may further comprise opening the piston means so that the annular space is opened and pulling force may be exerted on the tubular string. The weight of the tubular string is transmitted through the inner core assembly. Rotation of the tubular string creates torque which is transmitted to the inner core assembly.

Rotation may be stopped and the coiled tubing is pulled out of the tubular string.

It is a principal object of the present invention to provide a blowout preventor system above the rig floor within the drill string to allow sealing off of downhole pressure in order to do work on a side entry or top entry device above the swivel.

It is a further object of the present invention to provide a blowout preventor system in the drill string above the rig floor which can withstand the weight of the drill string without damage to the blowout preventors.

It is a further object of the present invention to provide a blowout preventor system in the drill string above the rig floor which would allow for a plurality of separate outer core assemblies aligned in sequence. This embodiment allows the apparatus to withstand the weight of the drill string but avoid the outer core assembly from being damaged.

It is a further object of the present invention to include a method and apparatus, which would provide a blowout preventor type of seal assembly in the drill string that would allow one to pick up the entire weight of the drill string tubing or pipe and still be able to rotate from the top and have the torque completely go through the apparatus in order to rotate the pipe below it.

It is a further object of the present invention to provide a system which would allow tools or pipe to enter down the center bore of the apparatus, and would allow the apparatus to be closed to control downhole well pressure in the event any tools or pipe above it would need to be worked or changed. Thus, curative work could be performed while controlling well pressure below the apparatus.

It is a further object of the present invention to provide a system for use on chemical cutting or regular logging applications where you can use with high pressure tubing connections or high pressure connections that includes a grease head on top to control well

pressure. This would allow one to eliminate the Bowen quick connections which are normally used without elevators and would not have pulled on the tubing below.

It is a further object of the present invention to provide a system which is applicable when doing many types of applications, for instance, the operator is able to pull while chemical cutting the pipe below with heavy loads and still have the availability to rotate the pipe. Prior art blow out preventors cannot rotate or withstand heavy loads. The present invention solves these problem.

An advantage of the present assembly and method is that in the present state of the art, there are no drill pipe blow out preventors (BOP) with seal assemblies that would allow one to pick up the entire weight of the drill string, tubing or pipe without damaging the apparatus. Furthermore, there are no current BOP assemblies which would enable one to rotate from the top and have the torque completely go through the BOP assembly to rotate the pipe below the assembly. The apparatus of the present invention will rotate with the pipe. It could be used when the wireline strands in the grease head and on the pack off assembly have a leak or any of the connections above the assembly within the lubricator are leaking. With the use of the apparatus of the present invention, one would be able to hold the load of the drill string and seal off on any items such as wireline that the seals are installed to fit, and in turn, the operator could correct the problems above the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

For a further understanding of the nature, objects, and advantages of the present invention, reference should be had to the following detailed description, read in conjunction with the following drawings, wherein like reference numerals denote like elements.

Figure 1A is a cross-section view of the apparatus, which is one of the preferred

embodiments of the present invention.

Figure 1B is a partial cross-section view of the apparatus seen in Figure 1A.

Figure 2 is a perspective view of the outer core assembly of the apparatus seen in Figures 1A and 1B of the present invention.

Figure 3 is a cross-section view of the outer core assembly taken from line 3-3 of Figure 2.

Figure 4 is a perspective view of the pistons of the apparatus engaging a wireline.

Figure 5 is a cross-section view of a second embodiment of the apparatus having a composite double outer core assembly.

Figure 6 is a cross-sectional view of the pistons of the double core assembly from Figure 5 engaging a wireline.

Figure 7 is a cross-sectional top view of the view of the top pistons taken along line 7-7 of Figure 6 engaging the wireline.

Figure 8 is a schematic illustration of the single apparatus of the present invention seen in Figure 1 positioned below a swivel for use during wireline work in the drill string above the rig floor.

Figure 9 is a schematic illustration of a third embodiment of the apparatus having a pair of outer core assemblies positioned below a swivel for use during wireline work in the drill string above the rig floor.

Figure 10 is a schematic illustration of the apparatus below the swivel and above a side entry sub above the rig floor.

Figure 11 is a schematic illustration of outer core assemblies positioned below the swivel but above a side entry sub in the drill string above the rig floor.

Figure 12 is a cross-sectional view of the preferred embodiment of the trap door

assembly.

Figure 13 is a cross-sectional view of the trap door assembly taken from line 13-13 of Figure 12.

Figure 14 is a cross-sectional view of the trap door assembly taken from line 14-14 of Figure 12.

Figure 15 is a cross-sectional view of a second embodiment of a high torque and high capacity rotatable center core assembly with piston means.

Figure 16 is a schematic view of the assembly found in Figure 15.

Figure 17 is a partial cross-sectional view of the assembly taken along line 17-17 seen in Figure 16.

Figure 18 is a schematic illustration of the preferred embodiment of the present invention seen in Figure 15 positioned below a swivel for use during wireline work in the drill string above the rig floor.

DETAILED DESCRIPTION OF THE INVENTION

Figures 1-14 illustrate the preferred embodiments of the apparatus and system of the present invention as would be utilized in a work string, such as a drill string. Applicant herein incorporates by reference copending application bearing serial number 10/190,193, as well as application bearing serial number 09/994,161.

Referring to Figure 8, the apparatus 10a, which may be referred to as a high torque floatable seal body assembly, would be threadedly connected to a drill string 16 below a locking or regular swivel 14. In effect, the high torque floatable seal body apparatus 10a would be an apparatus for use as a blowout preventor within the drill string 16 above the rig floor 18, as seen in Figure 8. Prior art blowout preventors were placed below a packoff 20 of a side

entry device 22.

In operation, the apparatus could be utilized as a single apparatus as seen in Figures 1A and 1B; or, a pair of outer core assemblies, positioned atop one another, as seen in Figure 9; or, as a composite double outer core assembly as seen in Figure 5. In each configuration, the operation of the apparatus would be to carry out the same function.

Reference is made to Figure 1A where is seen a cross section view of the single apparatus 10a which includes the outer core assembly 30a, and an inner core assembly 32a having a threaded portion 34 on its upper end and a male threaded portion 36 on its lower end. The upper threaded end 34 would connect to the lower end of the swivel, for example, 14, as seen in Figure 8, and the lower end 36 of the inner core assembly 32a would attach to the section of drill pipe 16, as illustrated in Figure 8.

The inner core assembly 32a includes a continuous longitudinal bore 38 therethrough, as seen in Figures 1A and 1B, for allowing the flow of fluids or other concentric items such as coiled tubing or wireline therethrough as it is inner-connected between the swivel and the length of drill pipe as is appreciated by those of ordinary skill in the art. It should be noted that like numbers appearing in the various figures refer to like components.

As seen in Figure 1A, the inner core assembly 32a would also include a radial transverse bore 40a extending across its entire width which would intersect the vertical bore 38 therethrough. Transverse bore 40a would house piston 70a therein as would be described further. A second bore 40b and second piston 70b are disposed within the apparatus 10a.

The inner core assembly 32a further provides a substantial shoulder portion 42, as seen in Figure 1A, for allowing the outer core assembly 30a to rest thereupon, as will be discussed further, during use of the apparatus 10a. Further, there is noted an annular indentation 44 around the wall of inner core assembly 32a which would house a ring 45 (sometimes referred to as sleeve 45) which would maintain the outer core assembly 30a to rest

[redacted]

on shoulder 42, again as will be discussed further.

As further seen in Figure 1A, expanded shoulder 42 would hold the outer core assembly 30a in line by pin members 47a, 47b that will maintain the outer core assembly 30a and allow rotation with the inner core assembly 32a. Pin members 47a, 47b are inserted into apertures 47c, 47d in the shoulder 42 and corresponding apertures 47e, 47f in outer core assembly 30a. The pin members 47a, 47b will allow slight longitudinal movement up and down as the weight of the drill string creates a certain amount of stretch. The pin members 47a, 47b are large enough to keep the inner core assembly 32a and the outer core assembly 30a rotating together and keeps the entire apparatus 10a in line. The pin members 47a, 47b may be attached to the shoulder 42 by conventional means such as thread engagement.

The ring 45 slides on the upper portion of the inner core assembly 32a and would be locked as seen in Figure 1B. The ring 45 will keep the outer core assembly 30a in line with inner core assembly 32a so that under heavy loads, although inner core assembly 32a may have stretch, the ring 45 will allow inner core assembly 32a to stay in line. When the apparatus 10a is required to be activated i.e. closed, the pistons 70a, 70b will properly seal since there is no bending motion or torque on the outer core assembly 30a. The pistons may be referred to as rams.

Turning to Figures 2 and 3, there is illustrated the outer core assembly 30a which in the preferred embodiments is either a substantially cubical shape but can also be a circular shaped block. The outer core assembly 30a seen in Figure 2 contains a first vertical bore 52, the bore 52 having an interior diameter substantially equal to the exterior diameter of inner core assembly 32a. The inner core assembly 32a will be disposed within the bore 52. There would further be provided transverse bores 54a, 54b extending through each end 55 of the outer core assembly 30a which would be in communication with the bore 52. Figure 3 depicts a cross-sectional view of the outer core assembly 30a seen through line 3-3 of Figure 2.

Referring again to Figures 1A, the two bodies 30a and 32a work in combination. That is, the outer core assembly 30a would be slidably engaged upon the upper end of inner core assembly 32a in the direction of arrow 60 seen in Figure 1A, so that the outer core assembly 30a would then come to rest upon the upper surface of shoulder 42. When coming to rest on shoulder 42, the transverse bores 54a, 54b of outer core assembly 30a would be in alignment with transverse bore 40a, 40b respectively in the inner core assembly 32a, and would be maintained in line by the pin members 47a, 47b as described earlier. It should be noted that bores 54a, 54b would be aligned with bores 40a, 40b respectively. When that particular alignment is complete, there would then be provided the ring 45 which as seen in Figure 1A, placed into the groove 44 in the wall of inner core assembly 32a, so as to maintain the outer core assembly 30a between the shoulder 42 and the ring 45 so that the outer core assembly 30a would minimally move up and down during use.

In Figure 1A, outer core assembly 30a is illustrated resting on shoulder 42 with the transverse bores 54a, 54b of block 30a aligned with bore 40a, 40b of inner core assembly 32a. In order to assure the proper alignment and to ensure that the pistons 70a, 70b which would be operated within the bore 54a and 54b are properly engaged, there would be included a sleeve 57a, 57b, cylindrical in nature, which would slide within each of bores 54a and 54b and terminate within the notched area 31a, 31b in the body wall of inner core assembly 32a. When both sleeves 57a, 57b have been disposed within bores 54a, 54b, and engaged into the notches 31a, 31b, it is therefore assured that the bores 40a, 40b and bores 54a, 54b are properly aligned.

Figure 1A further illustrates the outer core assembly 30a disposed about the inner core assembly 32a with piston members 70a, 70b having been inserted into each of the bores 54a, 54b of the outer core assembly 30a. The piston member 70a, as illustrated, would be threaded through a cap 71a which would be threaded into the bore 54a and sealed therein

with O-rings. Piston 70a would be secured to the end of a threaded shaft 73a threaded through cap 71a, so that rotation of shaft 73a would move piston 70a in or out of bore 54a as needed. Piston 70b is similarly constructed with cap 71b and shaft 73b.

Reference is now made to Figure 4, where the pistons 70a, 70b are seen in isolated view being moved inwardly to grasp the wireline 77 to prevent fluid flow past that point. It should be noted that the pistons 70a, 70b may also be referred to as rams 70a, 70b. The pistons 70a, 70b move inwardly, as denoted by arrow 81a. For instance, rotation of shaft 73a moves piston 70a inward.

Returning to Figure 1A, the sleeves 57a, 57b in the bores 54a, 54b would also be sealed with O-rings to assure that any pressure which would be contained within the apparatus 10a (and which is generated by the well) would be sealed therein. The numerous O-rings provided with the apparatus 10a are denoted by the letter "O". The details of the operation of the pistons are not novel in the sense that the pistons used would be the same pistons that are used quite commonly in the industry on such tools as the Bowen blowout preventors, commercially available from Bowen Oil Tools Inc. under the name Blowout Preventor. Additionally, details of the operation of the O-rings are well known in the art. O-rings are commercially available from Industrial Products Inc. under the name Viaton.

Reference is now made to Figure 5 which illustrates a second embodiment of the apparatus, denoted as 10b, having a composite double outer core assembly 32b. Figure 5 depicts an inner core assembly 32b having a bore 38 therethrough, an upper thread engagement 34 and a lower thread engagement 36. Unlike the inner core assembly 32a seen in Figure 1A, this particular inner core assembly 32b would include a pair of lower transverse bores 40a, 40b and a pair of upper transverse bores 40c, 40d so as to accommodate two sets of pistons, namely 70a, 70b and 70c, 70d. As with the embodiment as seen in Figure 1A, the apparatus 10b of Figure 5 would include the pin members 47a, 47b which would function in the

same manner. Again, there is also included the shoulder member 42 and the upper ring 45. As seen in particular in Figure 5, the composite double outer core apparatus 30b comprises a lower 54a, 54b and an upper set of transverse bores 54c, 54d, which has been slidably engaged in the direction of arrow 60 onto the inner core assembly 32b. There is illustrated sleeves 57a, 57b, 57c, 57d of the type that would be slidably engaged into the bores 54a, 54b, 54c, 57d, respectively, of the block assemblies and would be latched within notches 31a, 31b, 31c, 31d. The double outer core apparatus 30b would accommodate a pair of pistons therein, namely top pistons 70c, 70d and bottom pistons 70a, 70b. This particular embodiment constitutes a more effective mode to be able to maintain a double seal via double pistons 70a, 70b and 70c, 70d against the wireline 77.

Figure 6 depicts a cross-sectional view of the pistons of the double core apparatus 30b in the closed position. As illustrated in Figure 6, the double seal is seen with the upper set 70c and 70d and lower set of pistons 70a, 70b grasping the wireline 77 to effect a more effective seal than a single set of pistons 70a, 70b as was seen with the embodiment of Figure 4. As seen in Figure 6, the piston member 70c is connected to shaft 73c which may be operated either hydraulically or manually. Depending on the rotation of shaft 73c, the pistons move either interiorly or exteriorly relative to the outer core assembly 30b. Pistons 70a, 70b are moved inwardly as denoted by arrows 81a, 81b. Pistons 70c, 70d are moved inwardly as denoted by arrows 81c, 81d. Once pistons 70a, 70b, and pistons 70c, 70d are in place, they would seal against, for example, a wireline 77 which is disposed through the bore 38 in order to sealingly engage therein.

Figure 7 illustrates a partial cross-sectional top view of the top pistons 70c, 70d taken along line 7-7 of Figure 6 moved inward engaging the wireline 77. Therefore, should there be any problems with the wireline while in use, the positioning of the apparatus 10b below the locking or regular swivel 14, one would simply engage the pistons 70a, 70b, and pistons 70c,

70d to close off the bore 38 and sealingly engage wireline 77 which in turn prevents any fluid flow and/or pressure flow through the bore 38 above the apparatus 10b.

In the event that the embodiment of the outer core assembly 30b and inner core assembly 32b has to take a very heavy load of the work string, there is a chance that the inner core assembly 32b will have some stretch due to the load. Should this occur, the transverse bores 54a, 54b, and bores 54c, 54d will become slightly misaligned with the bores 40a, 40b and 40c, 40d of the inner core assembly 32b, which could affect the ability of the pistons 70a, 70b and pistons 70c, 70d from moving in and out of the inner core assembly 32b. It should be noted that this misalignment would also be similar for the single embodiment seen in Figs. 1A, 1B.

Therefore, in some cases it may be preferred to employ multiple points of sealing against the work string (i.e. pistons 70a, 70b and 70c, 70d) with multiple outer core assemblies 30a of the type illustrated in Figure 1A. Therefore, instead of a single outer core assembly, there are a pair of outer core assemblies which would constitute an individual upper block 30c and a lower block 30d engaged upon a double bore inner core assembly 32c of the type as seen in Figure 9.

As seen in Figure 9, which is the preferred embodiment of the present invention, the upper outer core assembly 30c and lower outer core assembly 30d would be slidably disposed on the inner core assembly 32c. This differs from the double composite outer core assembly 30b seen in Figure 5. In effect, the same assembly would be in place as was discussed in Figure 1A, other than it being two outer core assemblies, i.e. an upper outer core assembly 30c and the lower outer core assembly 30d. Thus, in Figure 9 there is illustrated a first 30c and second block 30d positioned on a double bore inner core assembly 32c, thereby creating the double piston effect of Figure 5; however, two separate and distinct outer core assemblies 30c, 30d are employed which lessens the risk of failure and misalignment due to stretching

when the apparatus is subjected to a load.

More particularly, a desirable effect of having two separate blocks as seen in Figure 9 is that should a significant downward pull be exerted on the drill string 16, and some stretching occur in the inner core assembly 32c, each separate outer core assembly 30c, 30d will move with the stretch, and any misalignment of the transverse bores of the first outer core assembly with the inner core assembly does not necessarily mean misalignment of the transverse bores of the second outer core assembly with the inner core assembly.

Referring again to Figure 8, it is important to understand that one of the functions of the apparatus 10a is to allow the apparatus 10a to be placed in the drill string. When it is placed in the drill string 16, this in effect would allow one to seal off the opening in the apparatus 10a where there may be wireline 77 with a bottom hole assembly 78 attached thereto which extends therethrough and to undertake any curative or maintenance work above the apparatus 10a on the rig floor 18. However, one of the problems is that once the apparatus 10a is sealed off, the apparatus 10a may have to carry the entire weight of the drill string which may be hundreds of thousands of pounds or even more.

One of the reasons that the outer core assemblies seen in Figure 9 are kept separate is that when the entire weight of the drill string is pulled on the inner core assembly 32c, there is some stretching of the inner core assembly 32c. Therefore, by having separate assemblies 30c, 30d, when any stretching occurs in one outer core assembly, then it does not necessarily follow that the other outer core assembly would be warped or damaged in the same way since they are separate from one other. If the pair of assemblies were kept in one block, then when the stretching of the inner core assembly 32 would take place, it is possible that the block itself would be compromised and the pistons may be pulled upward or downward as the case may be thereby creating the misalignment. In Figure 9, because each outer core assembly 32c, 32d is allowed to float separately from one another, any deformation of one outer core

assembly does not necessarily mean the deformation of the other outer core assembly.

As noted earlier, each apparatus includes O-rings, also called polypacks, to keep well pressure from leaking out from the well into the atmosphere which, as those of ordinary skill in the art will appreciate, could lead to a safety risk. O-rings are well known in the art. For instance, in Figure 1A, the outer core assembly 30a has O-rings, such as seen at 79a which will seal against the upper sections of outer core assembly 30a to maintain pressure internally. Furthermore, outer core assembly 30a will have O-ring 79b to seal against the sleeve 57a when locked in place of the whole assembly to maintain internal well pressure. Other O-rings are denoted by the letter "O". The piston members that are disposed within transverse bores 54a, 54b has O-rings on the outside to seal against the locking sleeve inside, as the piston members are hydraulically or manually closed to seal against the medium that is within the work string such as wireline, coiled tubing, snubbing pipe, etc.

Figure 8 illustrates a single apparatus 10a as was discussed earlier positioned below the swivel 14 and above a drill pipe 16. It is important that the apparatus 10a be positioned below a swivel 14 when one is using a side entry device 22 as illustrated in Figure 8, and one wishes to rotate the drill string in order to create downhole torque. The swivel 14 may be a locking swivel or regular swivel. If wireline 77 is rigged up and the apparatus 10a is above swivel 14, and one would want to rotate the drill string, rotation would cause the wireline 77 to become wrapped around the entire upper portion of the lubricator. Therefore, the swivel 14 allows the rotary table to rotate the lower portions of string while not rotating the upper part. When that occurs, the apparatus 10a would likewise rotate with the lower portions of string below the swivel 14. However, according to the teachings of the present invention, in the event that a problem develops, the apparatus 10a would be closed. Remedial curative action could then be undertaken.

As was discussed earlier, Figure 9 illustrates multiple outer core assemblies 30c, 30d

positioned below the swivel 14. This would be similar to the system as seen in Figure 8 but for the fact that there are two outer core assemblies 30c, 30d for the reasons as were discussed earlier.

Turning now to Figure 10, there is illustrated the apparatus 10a below a swivel, which can be a regular or locking swivel, and above a side entry sub 22 above the rig floor 18. Should a problem occur while the wireline is being used, and it becomes necessary to close apparatus 10a, one would close the apparatus 10a against the wireline to seal the pressure below it. The pressure above apparatus 10a can be bleed off and work can be done above the apparatus 10a as set out earlier. Also, the pressure line 25 can be used to kill the well below the apparatus 10a.

The apparatus 10a is positioned below a swivel 14 so that curative work may be done on that portion of the lubricator above the swivel 14 during use. In all cases, again, when this work would go on, the assembly 10a would be in the closed position, that is sealing off the bore where the wireline (or other tubulars such as coiled tubing) is concentrically disposed so as to prevent any pressure and/or fluid flow above the assembly 10a while work is going on above the apparatus 10a. In the Figure 10, a side entry sub 22 is rigged up with a fluid injection line 25 to the side out of the side entry 22. Tools would be entering down the center bore and the apparatus 10a can be closed to control well pressure below it. Once closed, any tools above it that need work or if any rubbers in the packoff need to be changed, the operator can do so. Additionally, the side entry tool 22 will allow you to still inject heavy fluids via the fluid injection line 25, or in the alternative, to bleed off pressure from below the apparatus 10a.

It should be noted that as an additional embodiment, it is possible to have multiple outer core assemblies utilized below the swivel 14 but above a side entry device 22 such as seen in Figure 11. Additionally, Figure 11 shows a coiled tubing string 80 being concentrically lowered into the drill pipe 16, as is well understood by those of ordinary skill in the art. An

annular space 81 is created by the coiled tubing string 80 concentrically positioned within the drill pipe 16.

Applications to chemical cut or electric line logging under high pressure and wherein tubing connections have a grease head on top to control well pressure can be used with this invention. This application would allow one to eliminate the Bowen quick connects which are normally used without the elevators and not able to pull on the tubing below when chemical cutting. Also, the elevators of the block would still be latched onto the tubing or drill pipe just below the grease head. When doing many types of applications, one is able to pull while chemical cutting the pipe below with heavy loads and still have availability to rotate the apparatus while prior art blow out preventors are unable to rotate or withstand heavy loads during such operations.

Referring now to Fig. 12, a cross-sectional view of the preferred embodiment of the trap door assembly 100 will now be described. Please note that the trap door assembly 100 is shown positioned above the swivel 14 in Figure 8. Returning to Figure 12, the trap door assembly 100 consist of a generally cylindrical sub 102 that has an outer surface and an inner bore 104. The trap door assembly includes a sleeve assembly 106 disposed within the inner bore 104. The sleeve assembly 106 contains a first diameter surface 108 that extends to a reduce diameter second surface 110. As seen in Fig. 12, a radial surface 112 of the sleeve assembly 106 seats on radial surface 114 of the cylindrical sub 102.

The sleeve assembly 106 contains a pivot point 116 for a pin, with the trap door 118 being pivoted from a closed position to an opened position as shown by the arrow 120. It should be noted that the trap door 118 is shown in three different positions within the sleeve assembly 106 by the shadow lines. The trap door assembly 100 also contains the kick gate assembly 122 which is disposed on the reduced diameter second surface 110. The kick gate assembly 122 is used to open the trap door 118 with the kick arm 124.

As seen in Figure 8, the trap door assembly 100 is connected on top of the swivel 14. More specifically, the cylindrical sub 102 has an internal thread 125a that connects to a portion of the lubricator, and an external thread 125b that connects to the swivel 14 as seen in Figure 8. With this design, weight of the drill string 16 is transmitted through the cylindrical sub 102, but is not transmitted to the separate sleeve assembly 106. Therefore, the weight of the drill string 16, as well as torque, will not be transferred to the sleeve 106. In prior art devices, the weight and/or torque would structurally effect the trap door which in turn causes the trap door to fail.

Figure 13 is a cross-sectional view of the trap door assembly taken from line 13-13 of Figure 12. As seen in Figure 13, the kick arm 124 pivots with the rotation of the shaft 126, wherein the shaft 126 and kick arm 124 are connected. The shaft 126 is disposed through the wall of the cylindrical sub 102, and the shaft 126 may contain a head with a profile therein for ease of rotating the shaft 126.

Referring now to Figure 14, a cross-sectional view of the trap door assembly taken from line 14-14 of Figure 12 will now be described. Generally, Figure 14 shows the trap door 118 in the closed position within the first surface 108 of the sleeve assembly 106, with the sleeve assembly 106 being disposed within the cylindrical sub 102 as previously set forth.

In operation, the kick arm 124 is moved by the rotation of the shaft 126 wherein the kick arm 124 will open the trap door 118, as better seen in Figure 12 by the shadow lines denoted 124a, 124b. Thus, the operator would open the trap door 118 via the kick gate assembly 122. The wireline (or other tubulars such as coiled tubing) can then be lowered therethrough. While the wireline is extending therethrough, trap door 118 will remain opened. Once the wireline and any downhole assembly attached thereto is pulled up through the sleeve assembly 106, the trap door 118 will close. The trap door 118 may be spring loaded to close.

Once the trap door 118 is closed, the wireline tools will be prevented from falling downhole. Thus, once the wireline and downhole assembly are above the tool trap 100, the operator would not have to worry about the tools falling back downhole if, for instance, the operator runs the tool string into the top of the lubricator. Additionally, the weight of the drill string, as well as any torque, is not transmitted to the sleeve assembly 106 thereby preventing damage to the trap door 118 and/or to the kick gate assembly 122. In one embodiment, a blade may be positioned on the trap door 118, and when the wireline is extending therethrough, the operator could close the trap door 118 and the blade disposed on the trap door 118 can cut the wireline.

Figure 15 is a cross-sectional view of a second embodiment of a high torque and high capacity rotatable center core assembly with piston means. More specifically, the assembly 150 seen in Figure 15 is the most preferred embodiment of this application. The assembly 150 includes a core assembly 152 (which may sometimes be referred to as an inner core assembly) that includes at a first end 153 the internal thread means 154 and wherein the first end extends to an expanded portion seen generally at 156. The expanded portion 156 extends to a second end 158, and wherein the second end contains the external thread means 160. As per the teachings of this application, the internal thread means 154 threadedly attach to a drill string pivoting member, which may be a swivel or top drive, and the external thread means 160 attach to work string such as a drill string within a well bore, as will be more fully explained later in the application.

The assembly 150 will have an internal longitudinal bore 162. Disposed within the longitudinal bore 162 is the wireline 77. It should be understood that other types of work strings, such as coiled tubing, snubbing pipe and other tubulars can also be disposed therein. The assembly 150 will also have a first transverse bore 164 disposed through the expanded portion as well as a second transverse bore 166 that is essentially aligned with the transverse

bore 164. Disposed within the first transverse bore 164 will be first piston means 168. The first piston means 168 comprises a collar 170 that contains external threads 172 that cooperate with internal thread means contained within the longitudinal bore 164. A first ram member 174 is attached to the collar 170. A moving means for moving the ram 174 into the longitudinal bore 162 is seen at 176. In the preferred embodiment, the moving means is a hydraulically controlled means; however, it is to be understood that other types of moving means are possible. For instance, manual means such as a rod with threads for manual turning can be used. Pneumatic moving means are also available. Figure 15 depicts hydraulic line 177a, for input, and hydraulic line 177b, for input and output. Hydraulic rams are well know in the art and are commercially available from Bowen Oil Tools Inc. under the name ram assemblies. As is well understood by those of ordinary skill in the art, the hydraulic rams generally work by providing hydraulic fluid to chamber 168a thereby moving piston 176 into bore 162. In order to force piston 176 outward, hydraulic fluid is inputted into line 177b and chamber 168b, thereby forcing the ram into the opposite direction i.e. out of bore 162.

Disposed within the second transverse bore 166 will be second piston means 178. The second piston means 178 comprises a collar 180 that contains external threads 182 that cooperate with internal thread means contained within the transverse bore 166. A second ram member 184 is attached to the collar 180. A moving means for moving the ram 184 into the longitudinal bore 166 is seen at 186, that includes a piston. Figure 15 depicts hydraulic line 177c, for input, and hydraulic line 177d, for input and output. Operation of the ram was previously described.

The assembly 150 further contains a sleeve 188 disposed within the bores 164, 166, as well as through the longitudinal bore 162. The sleeve 188 receives the ram 174 and the ram 184. The sleeve also has a pair of openings 190, 192 that communicate with the longitudinal bore 162.

The assembly 150 will also have a third transverse bore 194 disposed through the expanded portion as well as a fourth transverse bore 196 that is essentially aligned with the transverse bore 194. Disposed within the third transverse bore 194 will be third piston means 198. The third piston means 198 comprises a collar 200 that contains external threads 202 that cooperate with internal thread means contained within the longitudinal bore 194. A third ram member 204 is attached to the collar 200, with ram member 204 being known as blind rams. A moving means for moving the ram 204 into the longitudinal bore 162 is seen at 206, that includes a piston. Figure 15 depicts hydraulic line 177e, for input, and hydraulic line 177f, for input and output. Operation of the ram was previously described.

Disposed within the fourth transverse bore 196 will be fourth piston means 208. The fourth piston means 208 comprises a collar 210 that contains external threads 212 that cooperate with internal thread means contained within the transverse bore 196. A fourth ram member 214 is attached to the collar 210. A moving means for moving the ram 214 into the longitudinal bore 162 is seen at 216, that includes a piston. Figure 15 depicts hydraulic line 177g, for input, and hydraulic line 177h, for input and output. Operation of the ram was previously described.

The assembly 150 further contains a second sleeve 218 disposed within the bores 194, 196, as well as through the longitudinal bore 162. The sleeve 218 receives the ram 214 and the ram 204. The sleeve 218 also has a pair of openings 220, 222 that communicate with the longitudinal bore 162. It should be noted that while in the preferred embodiment, sleeves are included, it is possible to have an embodiment without sleeves. The sleeves aid in alignment of the bores. Also, the sleeves provide for a seal bore for placement of the rams. In cases wherein rusting and/or pitting has occurred, the operator can simply change out the sleeves in order to provide for a new seal bore.

Referring now to Figure 16 a perspective view of the assembly found in Figure 15 is

seen. Thus, Figure 16 depicts the first piston means 168, second piston means 178, third piston means 198 and the fourth piston means 208. The first end 153 extends to the expanded portion 156 which in turn extends to the second end 158. Note that the outer diameter of ends 153 and 158 are roughly the same as the drill string's outer diameter.

Figure 17 is a partial cross-sectional view taken along line 17-17 of the assembly found in Figure 16. Figure 17 illustrates a preferred embodiment of the equalizing means. As seen in Figure 17, the blind rams 204, 214 are closed, which severs the wireline 77, and the rams 174, 184 surround the wireline 77. The rams 174, 184 have a cut-out section that allows placement of wireline 77, as is readily understood by those of ordinary skill in the art.

A first bore 224, second bore 226, third bore 228 and fourth bore 230 within the core assembly 152 is communicated with the longitudinal bore 162. At the end of bore 224 there is situated therein a valve member 232, which in a preferred embodiment is a set screw device. The valve member 232 is communicated with a channel member 234 and wherein the channel member 234 communicates with the bore 226. At the end of bore 228 there is situated therein a valve member 236, which in a preferred embodiment is a set screw device. The valve member 236 is communicated with a channel member 238 and wherein the channel member 238 communicates with the bore 230.

In operation of the equalizing means, if the operator needs to close off blind rams 204, 214, pressure from the well will increase below the rams, seen at point P1. Valve member 232 would be closed. At some point, the operator would desire to open the blind rams 204, 214 and would therefore need to equalize the pressure. Hence, the valve member 232 can be opened, and the pressure at P1 can then be communicated with the channel member 234 which in turn communicates with the bore 162 (as denoted by the arrows). In the case where the rams 174, 184 were also closed, the pressure would now be communicated with the bore 228. The operator would cause the valve member 236 to be opened, which in turn would

communicate the pressure to the channel member 238 (as denoted by the arrows). The bore 230 communicates the pressure to the bore 162 above the rams 174, 184 thereby equalizing the pressure from below the rams to above the rams. Once equalized, the rams 174/184 and 204/214 can be opened.

Figure 18 is a schematic illustration of the assembly 150 seen in Figure 15 positioned below a swivel for use during wireline work in the drill string above the rig floor. The assembly 150 has the first end 153 attached to the swivel 14 and the second end 158 attached to the drill string. The wireline 77 is attached to the bottom hole assembly 78, as previously described. The swivel 14 is attached to a side entry device 22. Figure 18 is similar to the other schematic seen in Figures 8 through 11 in the sense that these Figures 8 through 11 depict a use of the assembly. Figures 8 through 11 generally depict the invention operatively associated with the drill string above the rig floor 18.

In the embodiment shown in Figure 18, the operator can exert a pull force, rotational force, perform longitudinal movement of the work string and other operations due to the novel design herein described. It should be noted that while Figure 18 depicts the assembly 150 used with a swivel 14, the assembly 150 can be used in a multitude of different applications. For instance, the assembly 150 can be placed below a top drive unit separated by a joint of pipe. The top drive will act like a swivel, when you set the slips and use the assembly 150 to close off the well and break out above the assembly 150. It is to be understood that as used in this application, a drill string pivoting member can be a swivel, top drive, or similar device. It is to be understood that as used in this application, a drill string pivoting member can be a swivel, top drive, or similar device. Hence, due to the novel features of the assembly 150, the assembly can be used in a multitude of applications.

The foregoing embodiments are presented by way of example only; the scope of the present invention is to be limited only by the following claims and any equivalents thereof.